

RUPTURE OF THE MALE URINARY BLADDER.¹

WITH AN ACCOUNT OF THREE CASES

BY ORVILLE HORWITZ, M.D.,

OF PHILADELPHIA,

Professor of Genito-Urinary Surgery, Jefferson Medical College; Surgeon to the Jefferson Hospital, St. Agnes's Hospital, Philadelphia Hospital, and to the State Hospital for the Insane.

RUPTURE of the bladder is a rare injury. Surgeons of large experience have been known to spend a lifetime in the active practice of their profession without meeting a case of the kind. In view of the fact that this accident is an emergency that may be encountered by the physician at any time; and that, moreover, the best methods to be adopted in order to arrive at a definite diagnosis, as well as the proper treatment to pursue, are still *sub judice*, we venture to hope that an account of the three cases that come under our supervision will not prove uninteresting.

The literature on this subject shows that about four cases are reported annually. It is, however, possible, that this figure underestimates the number that actually occur. As will be shown later on, rupture of the bladder may occur without the manifestation of any of the symptoms typical of the condition. Again, this accident may supervene and three or four days elapse before the individual becomes aware that he is seriously injured. As a result, death from peritonitis follows, and when an autopsy is denied, the demise is ascribed to some cause other than injury of the bladder. No doubt, in a small proportion of cases, no report is made, so that there is probably a percentage of which there is no record.

Owing to the infrequent occurrence of this injury, it naturally follows that no one person can be looked upon as an

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authority on the questions regarding diagnosis and treatment, which are still unsettled. It is only by the accumulation of data gleaned from the experience of those who have been fortunate enough to encounter cases of the kind that these points can be definitely determined.

Men are much more liable to this accident than are woman. Dr. Harrison (*Dublin Journal of Medical Sciences*, vol. xl) believes this to be due to the greater size of the female pelvis, the position of the bladder, as well as the shortness and distensibility of the female urethra; the canal acting as a safety-valve, permitting the bladder to be rapidly emptied when suddenly compressed. As rupture of the bladder is most commonly the result of traumatism, occupation would render woman less liable than man to an accident of the kind. This injury is seldom seen in children. A case of the kind occurring in a girl five years of age is reported by Robinson (*Lancet*, January 23, 1904).

Rupture of the bladder may be of idiopathic or of traumatic origin, the latter being by far the most frequent. The rent may be intraperitoneal; extraperitoneal; partially extraperitoneal and partially intraperitoneal; partially, where the mucous coat alone gives way; or subperitoneal, in which case both the mucous and muscular walls of the viscus are torn. This classification of the subject is adopted by most writers. The present writer believes the last three varieties to be extremely rare, for, after an extensive review of the reports of a large number of cases, he has, with one or two exceptions, been unable to find any that were not either purely intraperitoneal or purely extraperitoneal. For obvious reasons the former variety is by far the most common. All writers agree that this accident to the bladder is most likely to occur when the organ is distended; on the other hand, it may occur when the viscus is empty.

Routh reports a case (*British Medical Journal*, September 21, 1901) in which the injury followed a blow on the abdomen, the individual having emptied the bladder just before the accident occurred. Cabot, writing on this subject, states ("Refer-

ence Hand-Book of Medical Sciences," first edition, vol. i): "Great violence to the hypogastrium is capable of producing a tear in the anterior wall of an empty bladder. The accident is to be explained as follows: The force applied to the hypogastrium carries the upper portion of the bladder, which is attached to the abdominal wall by the peritoneum, and urachus violently backward. The lower portion of the bladder is held by the prostate, which is fixed by the pelvic fascia, and consequently a rent occurs in the anterior vesical wall just above the prostate. This is often accompanied by a considerable stripping-off of the peritoneum." He adds further: "Intra-peritoneal ruptures uncomplicated *can only occur when the bladder is full.*"

A few cases are recorded where more than one rupture the vesical walls has been found, but this is very rare. Although writers speak of a rent in the mucous coat of the viscus alone, we are convinced that this accident must be but very seldom encountered, for in no instance were we successful in finding a report of a case of the kind. If such an injury should occur, a diagnosis would be impossible without the aid either of a cystoscopic examination or of an exploratory suprapubic cystotomy. Reid reports a case of rupture of the mucous and muscular layers giving rise to a diverticulum composed of the peritoneal covering. An injury of this description is prone to be followed by peritonitis.

E. Ullman (*Wien. med. Woch.*, 1888) studied the subject of surgical and accidental rupture of the bladder experimentally. His investigations differed from those of Dittel in 1886, in that the abdominal wall was left intact at the time the experiments were made. As a result of his observations, he concluded that laceration of the peritoneal layer was most apt to occur, that of the muscular layer next, the mucous coat being most resistant. When the rectum was distended, by means of a colpeurynter, at the same time as the bladder, the rent was always found to be in the posterior wall of the organ, a fact worth bearing in mind when the rectum and the bladder are both distended previous to performing suprapubic cys-

totomy. It was discovered that the amount of distention of the bladder that could be effected without causing rupture varied widely in different conditions; that in rupture was more likely to occur in cases of cystitis than when the organ was in a healthy condition. In one instance rupture of an inflamed bladder occurred after 360 cubic centimeters of fluid had been injected. In a normal bladder, 1700 cubic centimetres of water were injected before rupture took place. In one case Ditelt injected 5000 cubic centimetres of water before rupture occurred. Knowledge gained by the study of these experiments has a most important practical bearing. It teaches that when it becomes necessary to perform a suprapubic cystotomy in those cases in which a chronic cystitis exists, there is always greater danger of rupture of the organ than if the operation is undertaken with the bladder in a normal condition. Furthermore, the danger is enhanced if the rectum is likewise distended at the same time. Clinical experience is not in accord with the statement of Ullman that the rent is most likely to take place in the posterior wall of the organ. In ten cases of which we have the notes, in which rupture of the bladder occurred preparatory to a suprapubic operation, the tear was extraperitoneal.

A case of this kind was reported by John A. Wyeth (*New York Medical Journal*, October 19, 1901) in which chronic cystitis necessitating drainage existed. The bladder was distended with fourteen ounces of water, whereupon rupture, with extravasation of urine into the space of Retzius, took place. Nine similar cases are reported by Ullman; two by Weinlechner; one each by Donod, Perier, Guyon, Ditelt, Ullman; and two from Albert's clinic. Rupture occurred after injecting respectively "150, 250, 200, 100, 200, 180, 400 cubic centimetres of fluid." Rupture was extraperitoneal in seven of the cases. Six submitted to the high operation, with three deaths; two were treated by means of catheter drainage, with one death and one recovery.

We are convinced, after an experience with over three hundred suprapubic cystotomies, in which both the bladder

and the rectum were distended by what is known as "the Garson-Peterson method," and from which no untoward results followed, that if ordinary precautions are taken in distending the bladder, rupture of the vesical walls will not occur. We believe that the rectal bag should not be employed unless the lower bowel is in a healthy state. The Peterson bag should be a small one, one not capable of holding more than ten ounces. We have seen surgeons insert a large bag and inject as much as twelve or fourteen ounces of fluid; in some instances the quantity of water that was required to dilate it was not even measured. This practice is most reprehensible, and cannot be too strongly condemned. Before the patient is brought to the operating table, and before the anæsthetic is given, the surgeon should ascertain the exact capacity of the patient's bladder. We have frequently seen the bladder of a patient under the influence of ether distended, without any previous investigation having been made in order to determine how far the organ could safely be distended with fluid. It is an invariable rule with us to distend the bladder and ascertain its capacity the day before the operation. If eight ounces of water can be retained comfortably without giving rise to pain, under no circumstances should more than nine ounces of fluid be injected into the organ after the patient is under the influence of the anæsthetic. With attention to these simple details, we are convinced that rupture of the bladder preceding a suprapubic cystotomy will seldom, if ever, be encountered. Space will not permit of a consideration of all the causes that give rise to rupture of the bladder. The accident may be associated with a fracture of the pelvis or be due to a direct blow on either the distended or the contracted organ; in the latter case it occurs but rarely. Idiopathic rupture may occur in cases of long-standing disease of the bladder, associated with stricture of the urethra, hypertrophy or atrophy of the prostate gland, or the presence of stone; one case reported followed the use of the aspirating needle. The accident occasionally occurs where both the bladder and the rectum are distended preparatory to a suprapubic cystotomy; in a few instances it has been known to take place spontaneously, the result of muscular

action. It occasionally occurs during pelvic operations. Alcoholism, as is well known, predisposes to the accident. M. Houel says, regarding this subject ("Des Plaies et des Ruptures de la Vessie," Paris, 1857): "Alcohol has a double influence in predisposing to this injury, for it causes an increased and rapid secretion of urine, and quick distention of the bladder; it also dulls the sensibilities of its mucous membrane, and the call to micturate is so feeble that it is disregarded by the drunkard, and the distention is allowed to increase, so that a man under the influence of liquor, with relaxed muscular system and distended bladder, who receives a blow on the abdomen, is extremely liable to sustain a rupture of one or more of the coats forming the vesical walls." It should always be borne in mind that rupture may take place from violent muscular action, in which case there will be neither evidence nor history of abdominal injury to account for the symptoms. Many interesting cases of the kind are recorded. Reginald Harrison ("Lectures on Surgical Disorders of the Genito-Urinary Organs," second edition) cites a case where the injury followed prolonged retention of urine. At the post-mortem examination no evidence of urethral obstruction could be found. A somewhat similar case is recounted by Havas ("Prest. Med.-Chir. Presse," October 27, 1901). In this case *prolonged retention* was attendant on *atrophy of the prostate gland*. The retention had existed for four days previous to the patient's admission to the hospital; at the time of his entrance he was in a state of collapse. The autopsy revealed a tear one inch long in the posterior wall of the bladder. When a patient is admitted to an institution in the condition just described, and no history is obtainable, it is easy to conceive how difficult it might be to make a diagnosis as to the cause of his symptoms. Gouley describes a case ("Diseases of the Genito-Urinary Organs") in which rupture of the bladder took place in a case of retention of the urine associated with rupture of the urethra. During the administration of ether the individual became greatly excited and struggled violently. Suddenly the abdominal tumor disappeared.

One case of idiopathic rupture of the bladder in which

the organ was extensively diseased and contracted on a calculus of large size has come under the writer's notice. The history of the case is briefly as follows:

CASE I.—The patient was seen, in consultation with a physician, in a neighboring town. He had been a sufferer from bladder trouble for about four years. On examination, a large calculus was discovered in a thickened and contracted bladder. Suprapubic cystotomy under local anæsthesia was advised. The patient consented to submit to the operation, but stated that he would not be ready to have it performed for at least a week. Five days later his physician telephoned the writer that he had been called to see his patient and found him in collapse, suffering violent pain over the whole of the lower portion of the abdomen; there was great desire to micturate, without the ability to perform the act. The catheter withdrew a small amount of bloody urine. Operative interference was not permitted. The patient died in twenty-four hours. At the autopsy a contracted and thickened bladder, containing a stone that almost completely filled the cavity, was discovered. The ureter on the left side was greatly thickened, the kidney being the seat of multiple abscesses. The kidney on the opposite side showed changes due to chronic nephritis. An intraperitoneal rupture, about one and one-half inches in length, was found on the posterior wall of the bladder.

A case was reported by Rowers (*Jour. de Chir. et Anns. de la Soc. Belge de Chir.*, No. 5, 1902), of a phosphatic stone, weighing 500 grammes, producing laceration of the anterior wall with an extravasation of urine into the prevesical space. Chappalin collected the records of twenty-nine cases of the kind, and found that perforation took place in the anterior wall in four; in the majority it occurred in the posterior or the inferior portion of the bladder.

Many cases of idiopathic rupture associated with urinary obstruction, such as stricture or hypertrophy of the prostate gland, are reported. A case is cited by Michel and Grosse (*Anns. d. Mal. d. Org. Gen.-Urin.*, September, 1899) in which the individual had suffered for ten days from retention of urine due to stricture of the urethra. Autopsy showed a large rent

in the left lateral aspect of the bladder, which was extraperitoneal.

Bennett reports a case of extraperitoneal rupture of the bladder following aspiration for the relief of retention of the urine, and from his experience concludes that aspiration should be resorted to only in those cases in which the bladder-wall is healthy; that if the urine is affected, the bladder should be irrigated, through the aspirating needle, with an antiseptic solution before the needle is withdrawn; and, finally, if there is reason to believe that the walls of the viscus are diseased, a large trocar should be used in place of the needle. This case is really one in which a rupture followed a puncture wound of the organ, the walls being weakened from long-standing disease. So far as we know, this is the only instance of its kind on record. We have frequently found it necessary to aspirate the distended bladder, the walls of which, in many instances, were far from healthy, without meeting a complication of the kind just mentioned. Our experience is in accord with that of many other surgeons. We believe that the danger of rupture of the bladder-wall following aspiration is very slight. We cannot agree that it is safer to use a trocar in place of the aspirating needle in cases in which the walls of the bladder are diseased. We have on several occasions seen, where the trocar was used in such cases, slight extravasation of urine into the prevesical space follow removal of the instrument, setting up cellulitis. When the aspirating needle is used this danger is minimized, as on the withdrawal of the needle the little opening in the bladder-wall is apt to contract and prevent leakage of urine. It is believed that in infected cases irrigation of the bladder, through the needle, with either a weak mercury bichloride or silver solution before the instrument is withdrawn, is a wise precaution. Harrison (*loc. cit.*), commenting on the case just described, says: "I do not think such a contingency will disturb the conclusions already drawn in the favor of this method of dealing with retention in certain cases where catheterism is impracticable. That there are persons so feeble or so diseased as to be incapable of enduring

the smallest puncture wound whenever and for what purpose it is made, will be admitted. The outlook for such individuals, should they be subject to retention of urine which the practitioner cannot relieve with a catheter, is most unfavorable, whatever alternative proceeding may be substituted for the best and most natural method of emptying the bladder. I believe, in the long run, a carefully performed aspiration will be found to be most expedient under these circumstances."

An interesting case of extraperitoneal rupture of the bladder following a puncture wound from the interior of the organ came under our care a few years ago.

CASE II.—The patient was admitted to the hospital in the afternoon, suffering from retention of urine of nearly twenty-four hours' duration. The resident physician inserted, with some difficulty, a filiform bougie, passed over a tunnel catheter, and withdrew the urine. Fearing that, in case the retention continued, he would have difficulty in reinserting the instrument, he decided to establish drainage by means of continuous catheterism. Finding it impossible to insert a rubber instrument, a small-sized silver catheter was passed and fastened *in situ*. We were called to see the patient in the evening of the same day and found him suffering from shock; temperature, 98° F.; pulse, 120; skin, moist and clammy; he complained of intense pain in the lower portion of the abdomen. The hypogastrium was tender, and the muscles were somewhat rigid. There was tenesmus, with the passage of a small quantity of bloody urine. Examination by rectum negative. Palpation, suprapubically, revealed slight induration, and some tenderness was detected. At first it was presumed that the shock was due to the urethral manipulation, with possible suppression of urine. In order to determine if the catheter might not, possibly, be obstructed by a blood-clot, a small quantity of hot sterilized normal salt solution was injected through the instrument into the bladder. It was then observed that the quantity of water returned was smaller than the amount injected. Rupture of the bladder was suspected. The space of Retzius was opened without disturbing the peritoneum. Immediately there was a discharge of bloody fluid having an urinous odor. Examination revealed a puncture wound in the upper

surface of the bladder-wall. This was enlarged, and the interior of the organ was examined and found to be normal. The stricture was dilated, a soft catheter inserted through the urethra into the bladder, and a drainage-tube placed in the suprapubic wound. The patient made an uninterrupted recovery.

On investigation it was learned that the table upon which the subject was brought from the operating room to the ward was about one and one-half feet higher than the cot; the patient being heavy and relaxed from the effects of the anæsthetic, difficulty was experienced in lifting him from the table to the bed. In doing so, the attendants accidentally let him fall a distance of about half a foot. It is presumed that at that time the beak of the catheter was thrust through the apex of the bladder. In this case a diagnosis would have been well-nigh impossible if the water test had not been made. The shock may have been due to the urethral manipulation, together with the effects of the ether. The bloody urine may have been the result of the urethral instrumentation. Tenesmus may have been due to irritation of the vesical neck. The absence of urine may readily have been due to suppression, which condition frequently attends long-standing stricture. The only suspicious and unexplainable symptoms present were the violent pain in the lower portion of the abdomen, marked suprapubic tenderness, and muscular rigidity.

The third case is one of unusual interest:

CASE III.—N. A. H., twenty-four years of age; laborer by occupation. Sent to the writer by Dr. E. Wagner, of Sunbury, Pa. While employed in cutting down a tree, it unexpectedly fell, throwing him to the ground. He landed on his back, with the tree on top of him. At the time of the injury the bladder was distended with urine. The patient states that at the time of the fall he felt as if something inside of him had been torn. He immediately began to suffer great pain in the lower portion of the abdomen. There was a frequent desire to micturate, but he was able to pass only a little blood. Shock was severe. The introduction of a catheter withdrew a quantity of bloody urine.

Catheterism was necessary for several days, when the urine began to pass naturally. Within twenty-four hours after the accident a swelling appeared in the perineum, which gradually extended to the scrotum and penis, which became very much discolored. A free incision into the perineum released a large amount of bloody urine. This was followed by immediate relief. A fistulous opening, through which all the urine was passed, formed in the perineum. On admission to the hospital, seven weeks after the accident, the patient was markedly septic; pulse, 100; temperature, 103° F.; chills, followed by fever; weak and emaciated. On examination, a fistulous opening in the perineum was discovered, which passed backward *alongside of the urethra, behind the prostate gland, to the base of the bladder*. Rectal examination disclosed a thickened cicatricial mass between the bowel, bladder, and prostate. What appeared to be a fistulous opening on the floor of the viscus, a little behind the prostate gland, was discovered by means of the cystoscope. Chronic cystitis was present. At the end of a month's treatment he gained in health and strength, and returned home convalescent, except for the urinary fistula, which still persisted. Four weeks later he returned to the institution. The fistulous tract was freely laid open, packed, and drained. It gradually healed, and at the present time the patient enjoys perfect health.

A somewhat similar case is reported by Harrison (*loc. cit.*) in which the patient sustained a fracture of the ilium and rupture of the floor of the bladder, with extravasation of urine into the tissues between the rectum and the bladder, dissecting downward towards the perineum. The case was relieved by peritoneal section, but death occurred, from exhaustion, on the seventh day.

When the cardinal symptoms of rupture of the bladder are present, the patient will state that, at the time of the injury, he experienced a sensation as of something inside having burst or given way. If retention of urine has existed for a long period of time, there may be a sensation of relief, which, however, is usually of short duration, as pain generally supervenes. The pain varies in intensity: it may be very slight or

very severe; it may be located in the vicinity of the bladder, the pelvis, or be diffused over the entire abdomen. There is usually a desire to micturate, without the power to do so. In some instances the urine is passed in small quantity. A small amount of blood may ooze from the meatus, or urine passed may be tinged with blood. On the other hand, the urine drawn by means of the catheter may be perfectly clear. Shock varies in intensity, but its presence is the rule rather than the exception. In some cases the individual may be able to walk, but does so with the body bent well forward. As a rule, however, especially if the rupture is intraperitoneal, there is inability to move after the injury. If no obstruction to the urethra exists, the catheter can usually be inserted without difficulty. A small amount of bloody urine may be obtained, and in some cases, on inserting the instrument a little further, a second escape of a larger quantity may occur. It must be remembered that in rare instances the appearance of symptoms may be delayed until three or four days after the accident. In a series of 78 cases analyzed by Stephen Smith, quoted by Gross ("Practical Treatises on Diseases, Injuries and Malformation of the Urinary Bladder"), it was found that the primary symptoms were severe in 59, in 43 of which the rupture was intraperitoneal; in 9 cases in which the peritoneum was involved *the symptoms were slight; in 3 they were absent*. Twenty-eight had retention of urine; in 3 the bladder retained its propulsive power; there was bloody urine in 25; clear, in 4. In only a few was there any evidence of external injury. Seven were able to walk after the injury, and 7 experienced a sensation as of something giving away when the rupture took place.

It is important to observe, from a medicolegal standpoint, that a severe laceration of the walls of either a contracted or a distended bladder may occur without there being any evidence of external injury. It should be an invariable rule to examine the condition of the bladder in all cases of fracture of the bony structure of the pelvis, or in those cases in which the patient is under the influence of liquor or insensible from

any other cause. Two cases of pelvic injury are cited by Harrison that were admitted to the hospital with rupture of the bladder, without symptoms, where an examination resulted in the diagnosis being made. The reports of cases of rupture of the bladder with delayed symptoms are sufficiently common to warn the surgeon to be always on his guard in dealing with pelvic injuries. Bloomer records a case (*British Medical Journal*, December 22, 1900) of a man who fell, while under the influence of liquor, striking the abdomen. Four days later, in spite of the fact that he had suffered from retention of the urine since the accident, he walked to the hospital, a distance of two miles. The abdomen was enormously distended. The catheter withdrew 196 ounces of bloody urine, after which the distention disappeared. Celiotomy was performed, and a rent was discovered in the posterior wall of the bladder, large enough to admit two fingers. Holmes saw a case ("Principles and Practice of Surgery") in which the man walked to the hospital thirty-six hours after the injury. The autopsy revealed an extensive laceration of the organ. In both of these cases the rupture was intraperitoneal.

A case is reported by Daley and Harrison (*British Medical Journal*, 1903) where, if the patient had been seen directly after the accident, diagnosis would have been extremely difficult, if not impossible. Definite symptoms did not make their appearance until three days after the injury. Operation was performed sixty-four hours after the accident. A rent in the posterior wall of the bladder was discovered and closed by means of sutures. The patient recovered.

A study of the irregular symptoms that may attend rupture of the bladder must impress the observer with the fact that a diagnosis of this injury is by no means always an easy matter. If the essential symptoms are present in conjunction with the history of the accident, it should not be difficult to arrive at a definite conclusion as to the character of the injury that the bladder has sustained. The likelihood of error becomes manifest when we take into consideration that an individual with a ruptured bladder may or may not be able to walk.

Shock may be present or absent. The patient may be able to expel the urine; on the other hand, micturition may be attended with difficulty or there may even be absolute retention. A slight amount of blood may dribble from the meatus, or there may be no sign of hæmorrhage. The urine, either passed naturally or obtained by means of a catheter, may be clear or bloody. Catheterization may result in the withdrawal of a large or of a small quantity of urine. The pain may be slight or severe. Finally, symptoms referable to the bladder may be delayed for several days after the accident; the development of peritonitis usually being the first indication as to what has occurred.

When we consider that the safety of the patient depends on an early recognition of the condition, with prompt surgical interference, it becomes apparent at once how essential it is to diagnose the injury with as little delay as possible.

Fortunately, in the majority of instances a history of injury to either the abdominal or the pelvic organs can be obtained; this, taken in conjunction with the urinary symptoms usually present, renders the diagnosis of rupture of the bladder an easy one to make. We agree with Alexander that valuable time should not be lost in attempting to make a differential diagnosis between an intraperitoneal and an extraperitoneal laceration. If it is certain that a rupture exists, operation should be proceeded with as soon as the patient can be prepared for the ordeal; trusting to an exploratory incision to reveal the exact nature of the injury, and dealing with it according to the indications.

In cases of extraperitoneal rupture, local symptoms may be present that will indicate the nature of the injury that the bladder has sustained. If the rent has taken place in the apex of the bladder, with an extravasation of urine into the pre-vesical space, the local symptoms will depend on the size of the wound in the organ. If the opening is small, the extravasation into the space of Retzius takes place slowly, and resembles, on palpation, an infiltrating mass. Should the tear be extensive, the urine escapes rapidly, flows beneath the peritoneum, and,

according to Gross ("System of Surgery," vol. ii, edition 6), "may extend as high as the umbilicus and kidneys, or as low down as the thigh, and passing through the obturator foramen." In either case there are usually rigidity of the recti muscles and tenderness on pressure in the region of the bladder. Guyon states that an extensive extravasation may stimulate a greatly overdistended bladder.

A case of intraperitoneal rupture is reported by Thomas G. Morton in which the extravasation of urine was largely into the muscular interspace of the abdominal walls, very little urine being found in the peritoneal cavity. A case of this description would render diagnosis impossible without the aid of an exploratory operation, and is certainly an argument against losing valuable time by attempting to diagnose the character of the injury without its aid.

As has already been pointed out in citing Case III, where the rent involved the base and neck of the bladder, the injury being extraperitoneal, the urine burrows forward towards the perineum and scrotum, simulating a rupture of the membranous portion of the urethra. Gross, speaking of spontaneous rupture from overdistention, states that, "The mucous and muscular coats generally give way posteriorly; in which the urine accumulates under the peritoneum as a kind of subsidiary pouch." Such cases, seen early, before extensive infiltration of urine has taken place, the diagnosis as to just what portion of the bladder-wall has been torn may be difficult, if not impossible, to make. Should, however, suprapubic and rectal palpation elicit undue tenderness in the vicinity of the neck of the bladder, together with unmistakable symptoms of rupture, there would be good reason for suspecting that the injury sustained was located at the base of the organ, and was probably extraperitoneal.

In those rare instances in which the mucous coat alone is torn, the only symptoms present will probably be pain, hæmaturia, frequent desire for micturition, and possibly only partial ability to expel the contents of the bladder. The only manner in which a diagnosis can be arrived at in a case of this descrip-

tion is by means of a suprapubic cystotomy. Where the mucous coat alone is torn, recovery may follow continuous catheterism; drainage being continued for at least two weeks, but as there are no certain means of diagnosing an injury of the kind, operation must be resorted to. The employment of a sterilized silver catheter for the purpose of diagnosis is probably attended with a minimum amount of danger of spreading the infection. It should be resorted to only, however, in doubtful cases. The use of the instrument, in spite of every precaution, may give rise to sepsis, and there is always the fear that an incomplete may be changed to a complete rupture, with attendant danger from extravasation of urine.

In our opinion the cystoscope should never be employed, as there is no means of telling whether the rupture is intraperitoneal or extraperitoneal. In order to use the instrument, the damaged bladder must be distended by means of either air or water, which has a tendency to increase the danger of infection if the peritoneum is involved.

Some writers advocate injecting filtered air into the viscus by means of a sterilized Davidson syringe around the nozzle of which cotton has been fastened. This method is strongly condemned at the present day. Walsham tried this test in two cases, collapse following in one instance; this condition, however, was relieved as soon as the abdominal cavity was opened. (*Trans. Med.-Chir. Soc.*, vol. lxxxiii.)

When the air test is made, if the bladder-walls are intact, the organ will become distended above the pubis, the air escaping through the catheter. In cases of extraperitoneal rupture, emphysema of the cellular tissue in the vicinity of either the rectum or the prevesical space will occur, depending on the situation of the laceration. If the rent is intraperitoneal, the air escapes into the general peritoneal cavity, and, according to Walsham, the liver dulness is lost. It is in this class of cases that collapse is likely to follow the experiment. If there is intestinal distention, this test is unreliable.

The injection test, suggested by R. F. Weir (*New York Medical Record*, January 22, 1887), consists in distending the

rectum by inserting a Peterson's rubber bag, which is filled with seven ounces of water; the bladder is then injected with a known volume of fluid. Should a marked pelvic tumor appear above the pubis, this must be due either to a distended bladder or to extravasation from an extraperitoneal rupture. Failure to recover all the fluid injected, by means of the catheter, would indicate an intraperitoneal rupture. Should there be no dullness on suprapubic percussion and only a portion of the fluid injected be recovered, the rectal bag should be withdrawn and a digital examination of the bowel made; if there is a postero-inferior subperitoneal rupture, it can readily be detected, for if the tear is intraperitoneal, no infiltration will be found, and the same quantity of fluid injected will be recovered.

In articles that have appeared recently on "Rupture of the Bladder," by Alexander and Jones (*loc. cit.*), both the infiltration of air and the injection of water tests are, in our opinion, very justly condemned. The infiltration test adds considerably to the shock and pain so frequently present; it lowers the individual's resisting power, and, as has already been pointed out, is not free from the danger of giving rise to collapse. It has a tendency to spread the infection throughout the peritoneal cavity and thus give rise to general peritonitis.

The injection test may fail to give reliable results in the face of a rupture of the vesical walls, owing to the fact that the opening may be very small, permitting a leakage of a small quantity of urine, the consequence of which may be very grave; yet when distended with air or water, fail to give positive results. The laceration may be valve-like in character, thus retaining air or water when distended, but permitting a leakage when in the state of contraction. White and Martin state ("Genito-Urinary and Venereal Diseases"): "The injection of an antiseptic solution is by no means an infallible test, since even an extensive rupture may so quickly close by inflammatory adhesions that a solution injected with gentle pressure fails to break this down, and the total quantity is at once returned."

Alexander cites two cases where both the infiltration and the injection failed to demonstrate the pressure of a rupture;

yet in both instances an extensive laceration was discovered,—one at the time of operation, the other at the autopsy.

It must not be forgotten that rupture of the bladder may exist without manifesting any characteristic symptoms. A contusion of the abdominal wall may give rise to subjective symptoms exactly similar to those produced by rupture of the vesical walls, even to the appearance of blood in the urine.

From what has been stated it is evident that there is no known means at our disposal that can be regarded as a reliable aid in attempting to diagnose rupture of the bladder. Attention is called to the fact that all the expedients suggested are fraught with more or less danger to the patient; the use of a sterilized catheter is probably less dangerous than any of the other expedients. It follows, therefore, that in all cases of doubt, instead of losing valuable time by employing measures that are frequently unreliable in a large number of cases, and that also add greatly to the danger to the patient, it is wiser to proceed at once with an exploratory operation, the treatment depending on the character of the injury that is found to exist. On several occasions we have found it necessary to make a differential diagnosis between suppression of the urine and spontaneous rupture of the bladder. The difficulty is enhanced if the patient is unconscious from alcoholism or injury. In cases of suppression of urine, if the patients are conscious, there is neither tenesmus nor abdominal or pelvic pain. A few drops of urine may pass, but a free stream never escapes. Blood is absent. By the insertion of a catheter a small amount of cloudy urine is usually withdrawn, an examination of which will show the presence of albumin and probably of casts. In cases of this description, if palpation suprapubically and by rectum is negative, the case should be regarded as one of suppression of urine due to some kidney complication. In doubtful cases the injection test, followed by the employment of the cystoscope, will be justifiable, the surgeon being prepared to operate immediately if a rupture is found to exist. Treatment may be summed up in a few words: operate in every case with as little delay as possible.

It is true that a few cases are recorded in which a rupture

of the bladder had taken place, and the individual recovered as the result of continuous catheterism. Notably, are those reported by Henry Morris, Greig Smith, Benham, and Thorp. The case of Benham and Smith was that of an imbecile who pushed an umbrella whalebone up the urethra into the bladder. Two years later he died of Bright's disease, and at the autopsy the whalebone was found, encrusted with phosphates, partly in the bladder and partly in the peritoneal cavity. At no time had there been any symptoms referable to the bladder or the peritoneum. In view of what has been accomplished by aseptic surgery in the past few years in lessening the shocking mortality of this severe injury, at the present day no progressive surgeon would be willing to depend on continuous catheterism as a method of treatment in cases of rupture of the bladder.

The literature on this subject shows that occasionally a rupture of the bladder may exist with either an absence or a delay of any symptoms that would lead the surgeon to suspect that the organ had been injured. Such cases finally develop peritonitis or die either from toxæmia or from septicæmia.

It has long been known that normal urine in a healthy bladder is sterile; when, however, it is confined in the peritoneal cavity, it is gradually absorbed and has a toxic influence on the blood; or it may undergo decomposition, giving rise to peritonitis. It has frequently been observed that in a wound of the bladder occurring accidentally during an abdominal operation, the urine extravasating into the peritoneal cavity, no deleterious results may be apprehended, provided the urine is sterile, the peritoneal cavity well irrigated, and an egress provided for its escape.

The experiments of Menzels (*Wiener med. Woch.*, Nos. 81, 85, 1869) prove conclusively that sterile urine in the peritoneal cavity is harmless so long as a free escape is provided for it. Keyes (Van Buren and Keyes, "Diseases of the Genito-Urinary Organs," 1874) found that *subcutaneous injections of fresh healthy urine* were followed by no signs of irritation.

The condition is quite different when the urine is loaded

with micro-organisms coming from an injected bladder. In such cases the extravasated urine is frequently mixed with blood, which, coming in contact with tissues whose resisting powers have been lowered by injury, and being confined in the structures without a vent for its escape, it rapidly undergoes decomposition, giving rise to wide-spread destructive inflammation, frequently associated with a grave form of septicæmia. The urinæmia which sometimes attends such cases is believed by Coates to be due to the fact that the urea is no longer eliminated from the system.

In cases of extraperitoneal rupture involving the base of the bladder the symptoms simulate those of rupture of the membranous urthra. In cases similar to Case III, cited by us in this paper, the best method of operating in order to give relief is to employ the technique that is suggested by Fuller for extirpation and drainage of the seminal vesicles. (*Journal of the American Medical Association*, May 4, 1891.) This operation has the advantage of freely exposing the base of the bladder. Should doubt exist as to whether or not the laceration involves the peritoneum, suprapubic cystotomy should be performed and the viscus explored. If it is then discovered that the tear extends into the peritoneal cavity, the abdomen should be opened and the wound in the bladder closed in the usual manner. In cases of extraperitoneal rupture with extravasation into the space of Retzius, the bladder should be opened suprapubically, the cavity of the organ explored, and if it is found that the laceration does not involve the peritoneum, the bladder should be drained as in the ordinary suprapubic cystotomy. When an intraperitoneal rupture is suspected, the prevesical space should be opened and the bladder incised; any clots that it may contain should be washed away, and a search be made to determine the position and character of the rent. As soon as the nature of the injury has been detected, the abdominal cavity should be opened, the patient placed in the Trendelenburg position, the intestines walled off by means of sterilized gauze, and the wound in the bladder-wall closed by means of sutures.

There are several questions regarding the technique of closing wounds of the bladder that are still unsettled. It is generally conceded that the wound is best closed with fine silk, as the catgut sutures cannot be depended upon to endure for a sufficient length of time. Several cases have been reported in which this latter material was employed, where a leakage occurred, owing to the too rapid absorption of the suture, death resulting from peritonitis. Only the muscular and serous coats are brought into apposition; two layers of sutures are employed for this purpose, the muscular layer being closed by the interrupted Lembert suture, and the serous by the mattress suture. An excellent suggestion was made by Alexander,—that of putting an additional interrupted suture a little beyond each angle of the wound, this having a tendency to render it additionally safe. The consensus of opinion is averse to distending the bladder after the wound has been sutured, in order to determine whether or not the wound is water-tight. It is believed that this is apt to tear out the sutures and may result in leakage. Moreover, in closing wounds of the intestines no such test is made in order to determine whether or not the approximation is accurate, and it would seem that the same law holds good in similar bladder injuries.

It is a moot point whether it is best to close the abdominal wall without suprapubic drainage of the bladder or establish suprapubic drainage and leave the abdominal cavity partially open, walling off the intestines by means of sterilized gauze. It is beyond question that the first is the ideal method to pursue; nevertheless in some instances where this plan has been adopted leakage of the wound in the bladder has taken place, and, there being no egress provided for the escape of urine, death has resulted from peritonitis. In these cases, if abdominal drainage had been provided, life would probably have been saved. In each instance the surgeon must rely on his judgment and experience. In view of the clinical experience of others, however, we are of the opinion that it is wisest to establish suprapubic drainage of the bladder, leaving the abdominal wound partially open, the intestines being protected by means of sterilized gauze.

Many writers speak of the difficulty often encountered in attempting to close a rent that is located posteriorly and towards the base of the bladder, being situated at a great depth in the pelvis. In a case of this description Alexander speaks highly of the employment of Smith's rectangular cleft-palate needle-holder, employing a small curved Richard's needle, was found to be of great value. The complete closure of the lower angle of the rent deeply seated is not only the most trying part of the operation, but a failure to approximate the edges of the wound completely has in several instances resulted in leakage, with death of the patient. Any expedient that has proved of service in such cases is worth recounting. The method adopted by Jones (*ANNALS OF SURGERY*, February, 1903) seems to be very feasible. He states that "The difficulty of suturing the lower end of the wound can be obviated largely by putting the patient in the Trendelenburg posture, by leaving the ends of each successive suture long, and by beginning to suture at the upper end of the wound. By this means the wound is pulled up within easy reach, and each suture below can be placed without difficulty. A round, full-curved needle in a needle-holder with a long handle which can be held by the fingers instead of the whole hand, that is, an elongated hæmostatic forceps with short powerful jaws, makes the suture a comparatively easy one." Cases in which the rupture is partly extraperitoneal and partly intraperitoneal should be treated on the same principle as an intraperitoneal rupture. In some instances the rent in the bladder-wall cannot be located even by an exploratory incision. Of six cases of rupture of the bladder reported by Thorndike (*Journal of Cutaneous and Genito-Urinary Diseases*, May, 1899), in two the openings in the bladder were not found; the wound was drained; both patients recovered. A number of similar cases on record. This only serves to demonstrate the truth of the statement that the danger of extravasation of urine in the peritoneal cavity is minimized by irrigation, free drainage, and by not allowing the urine to accumulate in the tissues.

The prognosis will vary with the character of the injury and the complications that may be present. It is rendered more

favorable by early diagnosis and immediate operation. In those cases in which the symptoms are delayed or are in abeyance, the outlook is usually grave. Previous to 1882 intra-peritoneal rupture was regarded as a fatal injury. Gross, writing on this subject, says: "Rupture of the bladder is nearly always fatal." Of 166 cases collated and analyzed by Dr. Max Bartels in 1882, 149 died and 17 recovered. Dr. D. F. Jones, analyzing 54 cases in 1903, found that there were 26 deaths and 28 recoveries, that is, a death-rate of 48 per cent. Taking, however, 22 of the cases published since 1892, there were 15 recoveries, giving a mortality of 27.5 per cent. Nothing more is needed in order to vindicate the claim made in this paper that the recovery of cases of rupture of the bladder depends on an early diagnosis and prompt operation.

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